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Submission by the Food and Agriculture Organization of the United Nations (FAO) on opportunities for actions with high mitigation potential, including those with adaptation and sustainable development co-benefits

In response to the invitation of the ADP "to submit to the secretariat, by 30 March 2014 and regularly thereafter, information on the opportunities for actions referred to in decision 1/CP.19, paragraph 5(a), including their mitigation benefits, costs, co-benefits and barriers to their implementation and strategies to overcome those barriers, including finance, technology and capacity-building support for mitigation action in developing country Parties."

The Food and Agriculture Organization of the United Nations (FAO) herein submits its views to the UNFCCC Secretariat in reference to the invitation above:

Combined emissions due to agriculture, forestry and other land use added up to more than 10 billion tons of CO_2 equivalents in 2010 according to FAO's dataset. This is more than 20 per cent of all greenhouse gas (GHG) emissions due to human activity. Crop and livestock production activities accounted for roughly half of these emissions. Future income and population growth will increase this already large contribution dramatically, unless low-emission growth strategies for agriculture are identified and applied.

Growth in the agricultural sector is essential for the least developed and other developing countries to meet their food security and development goals, which implies an inevitable increase in emissions.

The approach to agricultural mitigation in LDCs and other developing countries, then, is not an absolute reduction in current emission levels, but rather a reduction compared to a projected baseline of growth in emissions – e.g. a "business as usual" emissions growth path under conventional agricultural growth strategies. The impact of mitigation actions, in this context, could thus be assessed as a deviation from the baseline. This could be achieved for example by increasing resource use efficiency in food systems to achieve lower emission intensities (i.e. emissions per each ton of food produced) than those that would already characterize the baseline business-as-usual scenario.

Agricultural mitigation in developing countries needs to be pursued in the context of broader sustainable agricultural development and food security objectives, as provided by the climate- smart agriculture (CSA) framework. Mitigation choices must thus be linked with adaptation and resilience and should not take place at the expense of food security. There are many opportunities for generating mitigation co-benefits from agricultural growth strategies, and identifying these in specific contexts is an important component of building a CSA strategy.

As a GHG emitter, the agriculture sectors have significant mitigation potential both by limiting its own emissions, as well as enhancing carbon sequestration and storage in agricultural lands and aquatic systems. In general, this involves increasing resource use efficiency, reducing waste and enhancing ecosystem services in agricultural production systems.

FAO suggests the following considerations for designing approaches and actions to climate change mitigation in the CSA context:

Building an evidence base drawn from data on agriculture sectors, food security, potential climate impacts and mitigation potential, help identify activities with synergies between food security, adaptation and mitigation, as well as possible trade-offs. Given a lack of data and information in many developing countries, in a first stage, coarse analysis can be undertaken to identify key areas where mitigation actions can be complementary to food security and adaptation. Over time, necessary data and models for more sophisticated analysis can be built.

Taking a holistic and landscape approach to considering agricultural mitigation. Agriculture is an important driver of changes in land use (especially deforestation) due to the expansion of agricultural activities (livestock and crops) into forested lands or wetlands and aquaculture into mangrove forests. Approaches that look across different land uses and the trade-offs involved are needed in order to find solutions to the competition for land and water resources for food, energy, income and carbon-storage.

Coordinating climate change and agricultural/food security policies. Consistency across major agricultural, food security and climate change policies will be needed to achieve cost-effective mitigation in agriculture, avoiding perverse outcomes and ensuring a consistent set of incentives for adoption of priority options. At national and sub-national levels, institutional/legislative arrangements addressing improved systems for tenure rights, innovation and technology transfer as well as Measurement, Reporting and Verification (MRV) and payment for environmental services will be needed. In addition to national actions, farmers', fishers' and forest owners' and users' organizations, other parts of the private sector, extension services and local leaders, including CSOs and NGOs, have important roles to play at the local level.

Concrete examples of opportunities for actions in the agriculture sectors with high mitigation potential, including those with adaptation, food security and sustainable development co-benefits are described below.

1. **Land use change and mitigation potential**: Despite efforts to halt deforestation and other changes in land use, the conversion of ecosystems is still taking place at a large scale. Land use change causes emissions as stored carbon from soil and vegetation is released to the atmosphere. The annual GHG emissions from net forest conversion are estimated by FAO at the level of 3.8 Gt CO_2 eq in 2000–2010. The converted areas are mainly forests and degraded forests, and secondly drained organic soils and grazing lands turned into croplands. According to the Global Forest Resources Assessment 2010, the most important cause of deforestation is cropland expansion– both commercial and subsistence farming. Inefficient agricultural and grazing practices, land cover burning, and cultivation of non-food species also increase conversion of land; improved input efficiency and yields should thereby be prominent in any mitigation strategy. At the same time, sound regulations need to be put in place to avoid negative rebound effects.

   The priority for action is to sustainably improve efficiency and yields on the existing agricultural land. Degraded and abandoned land can also be rehabilitated and taken back to agricultural use. Improved grazing management could lead to greater forage production, more efficient use of land resources, enhanced profitability, rehabilitation of degraded lands and restoration of ecosystem services. For reducing illegal encroaching, robust monitoring systems, policies and legislation to notice and halt unwanted conversion are still needed in many places. Activities of reforestation and avoided deforestation in the tropics are estimated to have the greatest worldwide carbon sink effect with minimum opportunity costs in terms of foregone crop production.

There are several important barriers to reducing land conversion, including the lack of incentives to adopt alternative practices for smallholder and commercial agriculture, often arising from delayed returns, poorly functioning input and output agricultural markets, lack of extension support, and unclear land tenure systems. Reducing cropland expansion needs investment into building an enabling environment and incentives for sustainable and climate smart agricultural intensification.

2. **Mitigation potential in livestock production systems.** The livestock sector contributes nearly two-thirds of all agriculture non-CO_2 emissions. This makes the sector a significant contributor to climate change as well as suggests important potential to limit emissions. The emissions are mainly from enteric fermentation of ruminants and feed production and processing, with additional contributions from manure decomposition. Reductions in emissions can be achieved through wider use of existing efficient practices, technologies and changes in the production systems. The changes require adequate policies, education, awareness raising as well as financial incentives. GHG emission reductions are important in improving natural resource use efficiency as well as enhancing productivity which in turn can contribute towards improving livelihoods of the poor who depend on livestock. Better quality feeds, feed ration balancing and better manure management coupled with improved herd management and animal health can contribute to reducing GHG emissions. Moreover, it is estimated that with better management the global soil carbon sequestration potential of grazing lands could go up to 0.4-0.5 Gigatons. Improved grazing management practices can also increase animal productivity, resilience to climate change and ecosystem services.

3. **Mitigation potential in peatlands**. Peatlands cover only three percent of the global land area, but they store 30 percent of the world's soil carbon. Drained peatlands (0.2 percent of the global land surface), cause disproportionally large GHG emissions as direct CO_2. According to FAOSTAT estimates, they contribute up to 1 Gigaton of GHG emissions per year through oxidation, which makes them the third largest emitter after crop and livestock agriculture and net forest conversion. One of the main drivers of peatland drainage is agriculture that converts natural peatlands to plantations and other agricultural land. Especially, tropical forested peatlands are being cleared and drained for palm oil and pulpwood production. Moreover, peatlands emit also in methane, from drainage waters and during the rewetting cycles, while another important source of emissions are given by fires, quite frequent on drained peatlands.

   Conservation of the natural peatlands should be the priority. In case of utilisation, only responsible management practices should be implemented. An example of such practices is paludiculture. Paludiculture, biomass cultivation on wet and rewetted peatlands, presents opportunities for climate change mitigation as well as provides multiple environmental and socio-economic benefits, including contributions to food security. Paludiculture is also an adaptation measure halting land subsidence, which leads to decrease in land loss, flood and fire frequency and salt water intrusion. Though paludiculture establishment requires only low to medium technical knowledge, the up-front investment costs of rewetting drained peatlands still remain a major barrier to its implementation. In the absence of financial incentives, unsustainable peat swamp utilisation with short-term economic benefits override long-term responsible land-use options. To overcome some of these barriers, existing mechanisms, including REDD+ and NAMA should be used as incentives for rewetting and responsible land use practices on drained peatlands. Capacity development, knowledge and experience sharing about responsible management options as well as improved methodologies for MRV are needed in key peatlands countries.

4. **Mitigation potential in rice systems.** Agricultural CH_4 emissions account for about 50 percent of CH_4 emissions from human activities. About one-third of these emissions come from flooded rice production. Water management is a crucial factor affecting methane emissions from rice fields. Avoiding water saturation when rice is not grown and shortening the duration of continuous flooding during the rice growing season are effective options for mitigating GHG emissions from rice fields. Nevertheless, flooding management regimes that reduce CH_4 emissions increase N_2O emissions as sharp alternations in soil moisture are a driving force of N_2O emissions, so that careful strategies are required. There is substantial potential for mitigating agricultural GHG emissions through appropriate water management with the added benefit of improving water use efficiency and without reducing yields.

   System of Rice Intensification is a set of farming practices based on the principle of developing healthy, large and deep-root systems that can better resist drought, waterlogging and rainfall variability, all of which are potential impacts of climate change. It has proved particularly beneficial to some areas worldwide as it requires only intermittent water application to create wet and dry soil conditions, instead of continuous flood irrigation. Reductions in the amount of flooding of irrigated rice are likely to reduce CH_4 emissions, save water and possibly reduce N_2O emissions. Precision farming and placing nutrients closer to plants roots, such as deep placement of urea for rice, reduces emissions through reduced loss of nitrogen fertilizers. As cost implications of these improved systems are minimal, in many places, simply demonstrating these practices is sufficient to see widespread adoption.

5. **Mitigation potential in smallholder agriculture**: Currently, only limited data exist on GHG sources and sinks in smallholder agriculture, however this is an important sector to consider since it is where agricultural growth is particularly needed to achieve food security and poverty objectives. This implies the need for developing low emissions agricultural growth strategies suitable for smallholders. Increasing the resource use efficiency in agricultural systems, particularly through the better integration of crop-livestock activities to improve nutrient and organic matter management is one important means of doing so. Another is through the widespread adoption of sustainable land management techniques, including agroforestry, reduced tillage, improved grazing land management, reduced or no slash and burn, legume intercropping and rotations, and soil and water conservation measures have potential for creating substantial net carbon sinks while increasing local adaptation, sustainable development and food security benefits: e.g. agroforestry will prevent soil erosion, and improvements in soil nitrogen level can strengthen the resilience of ecosystems, increase crop yields, and consequently support food security. Results of the on-going research on atmosphere-biosphere exchange of GHG fluxes in some African smallholder systems will test the existing preliminary estimates and will inform on the mitigation potential of CSA practices, while adding needed information on their economic and social appropriateness for smallholder farmers. The barriers to adoption of such practices relate to availability of and access to labour, land and water, as well as up-front investment costs, climatic risks, gender roles, and physical conditions such as soil fertility and health which can be overcome with adequate financing and male and female farmers' access to extension services and necessary resources.

6. **Mitigation potential in fisheries and aquaculture.** The fisheries sector, including fishing, aquaculture, post-harvest and product distribution, is highly dependent on the use of external energy, particularly in the form of fossil fuels. Although traditional, low-input fisheries persist in many parts of the world, high-input, industrialized fisheries now account for the majority of global landings. Among these fisheries, particularly those targeting high value species, it is now common for direct fossil fuel energy inputs alone to exceed the nutritional energy embodied in the catch by at least an order of magnitude. Through improved governance and fisheries

management, alongside technological improvements, the fishing sector can substantially lower its fuel costs and reduce emissions. Reductions in fishing capacity and overfishing and changes in fishing practices and equipment can result in more economical and sustainable fisheries, can reduce food losses and waste and can contribute to improved food security. Barriers to the use of low-impact, less fuel-intensive practices include a perception that cost-efficient and practical alternatives are not available; ineffective technology infrastructure support and inflexible and inefficient fisheries management systems that restrict the rapid development and uptake of improved systems. Moreover, the sector lacks baseline data on GHG emissions which would enable MRV of the reductions.

In aquaculture, the primary GHG is CO_2, linked with fuel and energy use in direct production and with the production of key inputs, in particular feeds. There is good potential for reduction of GHG emissions by reducing reliance of fish meal/oil, reducing feed conversion factors and increasing traceability of feeds. Improved feed conversion ratio through better management can significantly contribute to emission reductions. A significant decrease in carbon emissions can be achieved by reducing mangrove deforestation and replanting mangroves in many aquaculture areas in Asia and other tropical regions through, for example, integrated aquaculture systems. Cultivating seaweed can enhance primary production in coastal waters and could contribute to increased carbon sequestration. The current seaweed price however prevents more farming. Semi-intensively managed pond aquaculture constitutes one of the most wide spread farming systems in Asia and these ponds can be highly productive, therefore, enhanced carbon management and potential capture could make a significant contribution to carbon sequestration in freshwater systems.

7. **Mitigation potential in improved efficiency of food chains and reduced food losses and waste**. Each year, approximately one-third of all the food produced for human consumption is lost or wasted. Including GHG emissions from land use change, the GHG emissions coming from food produced but not eaten are estimated to 3.3 Gigatons of CO_2eq. As the GHG emissions of each step of the value chain are adding up, the later the food is wasted along the chain, the higher its GHG emissions are.

   Reducing losses and waste requires important changes in systems, infrastructure investment, capacity building and behavioural changes. In designing food wastage reduction strategies their different environmental efficiencies need to be taken into account. Reducing food losses and waste has important potential for climate change mitigation, sustainable agriculture and food security.

Building financing mechanisms to support mitigation actions. Approaches to promote agricultural mitigation need to take into account: sector specificities, including agriculture sectors' crucial contribution to economic growth in developing countries to meet food security and development goals; its potential to generate benefits for food security and climate change adaptation and mitigation; a broader perspective on land use, including agriculture's impact on deforestation and the necessity to design institutional arrangements and financing, which can enable smallholders to implement mitigation actions.

This implies the development of financing mechanisms that are suitable to meet these challenges. For example**,** some forms of mitigation from smallholder agriculture are not cost effective for international compliance markets, due to low returns, high transactions costs or high risks. Nonetheless, when implemented over large groups of producers and areas, they could generate significant mitigation benefits. The development of cost-effective approaches to MRV for types of mitigation actions that allow for the flow of public sector mitigation financing is thus a priority for capturing cost-effective and climate-smart agricultural mitigation in developing countries. Public sector resources are needed to support the long term transitions and facilitate the flow of private sector finance, by funding capacity development, reducing risks to private sector investors and assisting in the development and dissemination of technologies. In developing countries agricultural NAMAs provide the vehicle for achieving this. Such NAMAs should be aligned with overall agricultural development and food security priorities, built upon evidence of the potential for capturing mitigation co-benefits from actions that generate food security and adaptation benefits, and linked to monitoring and financing mechanisms already operating in the agricultural sectors, such as national GHG inventories.